Graduate Study. Biostatistics is a field of science that uses quantitative methods to study life sciences related problems that arise in a broad array of fields. The program provides students with, first, related problems that arise in a broad array of fields. Students should have one year of calculus, a course in linear algebra or one year of biological course work; facility with a programming language; and upper-division work in at least one of Mathematics, Statistics and Biology.

**Graduate Adviser.** Jie Peng (Statistics)

**Courses in Biostatistics (BST)**

**Graduate**

222. **Biostatistics: Survival Analysis (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: Statistics 131C. Incomplete data; life table methods; hazard function; nonparametric methods; accelerated failure time models; proportional hazards models; partial likelihood; advanced topics. [Same course as Statistics 222.]—I.

223. **Biostatistics: Generalized Linear Models (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: Statistics 131C. Likelihood and linear regression; generalized linear model; Binomial regression; logistic regression; Poisson regression; quasi-likelihood; estimating equations; multi- variate GLMs. [Same course as Statistics 223.]—II.

224. **Analysis of Longitudinal Data (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course/Statistics 222, 223, Statistics 232B or consent of instructor. Standard and advanced methodology, theory, algorithms, and approaches relevant to the analysis of repeated measurements and longitudinal data in biostatistical and statistical settings. [Same course as Statistics 224.]—III.

225. **Clinical Trials (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course/Statistics 222 or consent of instructor. Basic statistical principles of clinical designs, including bias, randomization, blocking, and masking. Practical applications of widely-used designs, including dose-finding, comparative and cluster randomization designs. Advanced statistical procedures for analysis of data collected in clinical trials. [Same course as Statistics 225.] Offered in alternate years. —III.

226. **Statistical Methods for Bioinformatics (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 131C or consent of instructor; data analysis experience recommended. Standard and advanced statistical methodology, theory, algorithms, and applications relevant to the analysis of omic data. [Same course as Statistics 226.] Offered in alternate years. —III.

252. **Advanced Topics in Biostatistics (4)** Lecture—3 hours; discussion/laboratory—1 hour. Prerequisite: course 222, 223. Biostatistical methods and data analysis related to the following: genetics; bioinformatics and genomics; longitudinal or functional data; clinical trials and experimental design; analysis of environmental data; dose-response; nutritional and toxicology; survival analysis; observational studies and epidemiology; computer-intensive or Bayesian methods in biostatistics. May be repeated for credit with consent of adviser when topic differs. [Same course as Statistics 252.] Offered in alternate years. —III.

290. **Seminar in Biostatistics (1)** Seminar—1 hour. Seminar on advanced topics in the field of biostatistics. Presented by members of the Biostatistics Graduate Group and other guest speakers. May be repeated for up to 12 units of credit. [S/U grading only.]—I, II, III.

298. **Directed Group Study (1-5)** Prerequisite: consent of instructor. [S/U grading only.]

299. **Special Study for Biostatistics (1-5)** Prerequisite: consent of instructor. [S/U grading only.]

299D. **Dissertation Research (1-12)** Prerequisite: advancement to Candidacy for Ph.D. and consent of instructor. Research in biostatistics under the supervision of major professor. [S/U grading only.]

**Biotechnology**

[College of Agricultural and Environmental Sciences]

**Faculty.** Faculty includes members of the Department of Animal Science, on page 153; Engineering: Chemical Engineering and Materials Science, on page 253; Computer Science, on page 216; Engineering: Biological and Agricultural, on page 425; Food Science and Technology, on page 313; Land, Air and Water Resources, on page 364; Plant Pathology, on page 476; Viticulture and Enology, on page 541; and the College of Biological Sciences, on page 179.

**The Major Program**

Every living organism, from the smallest and most primitive bacteria to every plant, insect, animal or human being, contains DNA as the primary genetic material. DNA directs all cellular processes, creating the incredible variety and diversity of living organisms in the biosphere. Biotechnology focuses on the mechanics of life processes and their application. Biotechnology means “life technology” and represents an integrated, multidisciplinary field, with a profound impact today on almost every aspect of human endeavor.

**Preparatory Requirements.** UC Davis students who wish to change their major to Biotechnology must complete the following courses (representing the subject areas of Biological Sciences, Chemistry, and Mathematics) with a grade point average of at least 2.50 in each subject area. All of these courses must be taken for a letter grade:

- Biological Sciences 2A, 2B, 2C.............. 15
- Chemistry 2A, 2B, 2C.......................... 15
- Mathematics, one of the following groups: 6-8
  - Mathematics 1A, 16A, or Mathematics 17A, 17B; or Mathematics 21A, 21B

**The Program.** In the first two years, students develop a strong background in biological science with an emphasis on fundamental concepts and basic principles of genetics, molecular biology and cell biology. Four options, Animal Biotechnology, Plant Biotechnology, Fermentation, Microbial Biotechnology, and Bioinformatics, provide in-depth training and specialized knowledge in an aspect of biotechnology. Each option has a strong laboratory component to reinforce the theoretical concepts. Students also do an internship in a biotechnology company or university or government laboratory.

**Internships and Career Opportunities.** In the last decade, more industries are turning to biotechnology to solve problems and improve products, creating a growing job market for individuals trained in biotechnology in the agricultural, food and beverage, health care, chemical, pharmaceutical and biochemical, and environmental and bioremediation industries.

Graduates trained in the technologies designed for biotechnology will find their training applicable to advanced research in molecular biology, genetics, biochemistry, and the plant and animal sciences.

**B.S. Major Requirements:**

**Preparatory Subject Matter..............57-69**

- Biological Sciences 2A, 2B, 2C.............. 15
- Chemistry 2A, 2B, 2C.......................... 15
- Chemistry 8A, 8B or 118A, 118B, 118C, or 128A, 128B, 128C, 129A.............. 6-12
- Mathematics 16A, 16B, or 17A, 17B, or 21A, 21B.......................... 6-8
- Physics 7A-7B................................. 8
- Plant Sciences 120 or Statistics 100....... 4
- Biotechnology Options........................ 5

Select one course from:

- University Writing Program 101, 102A, 102B, 102C, 102D, 102E, 102F, 102G, 102H, 102I, 102J, 102K, 102L, 104A, 104B, 104C, 104D, 104E, 104F, 104I, 104T (may overlap with college composition requirement, may be waived by passing the upper division composition exam)

**Depth Subject Matter.................16-20**

- Biological Sciences 101.................. 4
- Biological Sciences 104................. 3
- Molecular and Cellular Biology 121 or 161.... 3
- Biotechnology 171......................... 3
- Internship or independent research; course 192 or 199 or Biotechnology 199.............. 3
- Undergraduate research proposal:
  - Biotechnology 188 (optional)............. 3
  - Honors undergraduate thesis (optional).... 1

**Areas of Specialization (choose one)**

**Fermentation/Biotechnology Option.................38-45**

- Microbiology 104; Biological Sciences 102 and 103; or Animal Biology 102 and 103; Microbiology 104L or Food Science and Technology 104L; Molecular and Cellular Biology 160L or Biotechnology 160L
- Biochemistry and Molecular Biology 115, 120, 140, 150, 170, Plant Pathology 130; and a second course from the previous list or one of Biological Sciences 181, 183, Molecular and Cellular Biology 182............... 23-30
- Restricted Electives........................ 15
  - Select from:

**Plant Biotechnology Option.................38-45**

- Microbiology 101, Molecular and Cellular Biology 126, Plant Sciences 152, Biotechnology 160, 161A, 161B, Biochemistry: Molecular Biology 105; or Biological Sciences 102 and 103; or Animal Biology 102 and 103............... 28-35
- Restricted Electives........................ 10
  - Select at least one course from each of the following areas:
    - (a) Pests, Pathogens and Production: Biological Sciences 181, 183, Biotechnology 150, 161, Plant Sciences 130A, 130B, Engineering: Computer Science

**Quarter Offered:** I-Fall, II-Winter, III-Spring, IV-Summer, 2013-2016 offering in parentheses. Pre-Fall 2011 General Education (GE): ArtHum=Arts and Humanities; SciEng=Science and Engineering; SciSoc=Social Sciences; Div=Diverse; Dom=Dominant Diversity; Writ=Writing Experience

**Fall 2011 and on Revised General Education (GE): AH=Arts and Humanities; SE=Science and Engineering; SS=Social Sciences; ACGH=American Cultures; DD=Dominant Diversity; OL=Oral Skills; QL=Quantitative; SL=Scientific; VL=Visual; WC=World Cultures; W=Writing Experience**
Bodega Marine Laboratory Program

http://bml.ucdavis.edu/

See also Biological Sciences, Bodega Marine Laboratory Program, on page 181.

In the 2014, the new multi-college B.S. in Marine and Coastal Science (MCS) major will start and the MCS field requirement can be fulfilled by any of the courses below.

Spring Quarter Program

A full quarter (15 units) of undergraduate core work in marine biology is available each spring quarter at the Bodega Marine Laboratory, located in Bodega Bay, California. Course offerings include lecture and laboratory instruction in the development of the international marine biology and physiologist's guide to the marine organisms, and population biology and ecology; coastal communities and an intensive individual research experience under the direction of a marine faculty (Biological Sciences courses 120, 120P, 122, 122P, 123, 125, 126, 126P, 140, 141, 141P). This is a 15 unit program and course offerings and instructors may vary from year to year. Applications are due January 31.

For more course detail, see full description under appropriate academic department listing or http://bml.ucdavis.edu/.

Summer Session Courses

This integrated program offers students a multidisciplinary understanding of coastal ecosystems through intensive, hands on lab and field courses taught at Bodega Marine Laboratory. The program offers students three sequences of instruction with up to 10 units in each. Two sequences occur during the first Summer Session and one sequence in the second Summer Session. Applications are due April 15.

For more course detail, see full description under appropriate academic department listing or http://bml.ucdavis.edu/.

Sequences are:
2. Effects of Coastal Pollution on Marine Organisms: Environmental Toxicology/ Nutrition 127
3. Oceanography: Environments and Policy 152; Geology/Environmental Science and Policy 150C; Biological Sciences 124

Course offerings, sequence structure and instructors may vary from year to year.

Bodega Marine Laboratory spring and summer programs are residential, with students housed on the laboratory grounds. Participants are assessed a